SOME RECENT CHANGES IN THE FLORA AND AVIFAUNA OF RABBIT ISLAND, WILSONS PROMONTORY, VICTORIA

INTRODUCTION

Rabbits were released on Rabbit Island as a food source around 1836 (Stokes 1846). More than a century later, in 1959, the island had an eroded area attributed to the presence of rabbits (Gillham 1961, 1962); however, the erosion might have been present in 1909 (Kershaw 1909). The rabbits had been affected by myxomatosis in 1965, when about 150 corpses were found. The use of carrots impregnated with '1080' poison (sodium fluoracetate) in 1966-67 apparently eliminated the remaining individuals since none have been seen since. Subsequently the area eroded diminished from 6.5 ha (16 acres) in 1965 to 0.6 ha (1.5 acres) in 1966 and has since disappeared. Revegetation in this area, initially and predominantly by *Senecio lautus* and then *Poa poiformis*, was assisted by prostrate species (e.g. *Carpobrotus rossii, Kennedya prostrata*), and the total number of vascular plants recorded from the whole island increased after removal of rabbits. As the previously eroded area was stabilised and colonised by plants, so was it invaded by nesting Short-tailed Shearwaters *Puffinus tenuirostris* (see Norman 1967, 1970 for further details).

This note includes observations made on the island in 1978 (5 and 10 December) and 1979 (10 December).

METHODS

Only specimens of the dominant plant species were collected in 1978 but in 1979 a more complete list of vascular species was compiled. A line transect was taken across the summit following a route used previously (figs 3-7 in Norman 1970); the percentage cover for each species present in contiguous 10-foot units was estimated. Photographs, for comparison with others taken between 1965 and 1968, were also obtained.

The distribution of shearwater burrows was determined by ground survey in 1978 when the island was divided into zones (Fig. 1). The numbers of burrows counted in circular quadrats (20 m²) placed semi-systematically throughout each zone were used to provide mean burrow densities which when multiplied by area (determined from an aerial photograph by planimeter) gave an estimate of the population. No allowance was made for the sloping terrain.

No systematic search was made for burrows of Little Penguin *Eudyptula minor* but their approximate distribution was noted, and other bird species present were also recorded.

FIG. 1—Distribution of burrows of Short-tailed Shearwaters and areas used in density measurements, 1978.

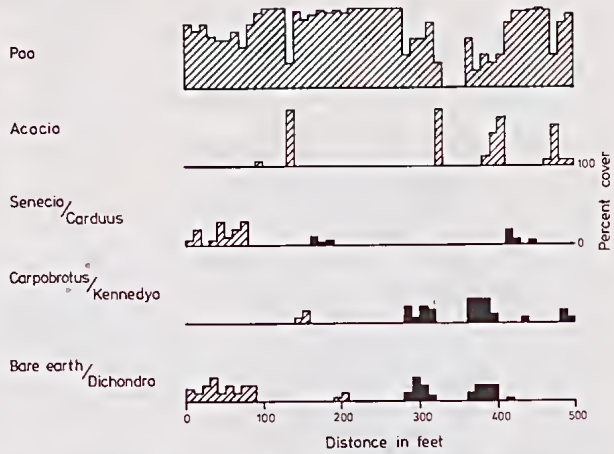

FIG. 2—Line transect, 10′ units, showing percentage cover provided by major species; summit, peg to Trig. point. (Compare figs 3-7, Norman 1970).

RESULTS

(i) Flora

Gillham (1960) recorded 24 vascular species, 4 of which were alien, from Rabbit Island. Between 1965 and 1968 a further 24 species were recorded, and during 1978 and 1979 specimens of another 15 species were collected (Table 1). A total of 63 vascular species (in 29 families) have now been recorded from the island; 14 of the species (22.2 per cent) are aliens (predominantly composites and grasses).

The lichens *Parmelia scabrosa* and *Teloschistes spinosus* were formally identified after our 1979 visit.

The beach region had changed markedly between visits in 1967 and those in 1978 and 1979. *Atriplex, Rhagodia* and *Tetragonia* had increased both in range and total area whereas *Cakile* and *Ammophila* had decreased (cf. Plate 15, fig. 1 with pl. 23 in Norman 1970). Behind the beach, and upwards towards the summit, *Rhagodia* had increased to invade some areas previously dominated by *Pteridium esculentum* or *Poa poiformis*.

More radical floristic changes were evident in the previously eroded area. In 1978 the number and size of the shrubs *Leptospermum laevigatum, Acacia longifolia* and *Leucopogon parviflorus* were a major feature of the island's central region where *Leptospermum* was most abundant. Within the *Poa* tussock community, more widely spaced here than elsewhere on the island, *Carpobrotus rossii, Acaena anserinifolia, Lobelia alata, Kennedya prostrata* and *Dichondra repens* were variously abundant. Bare areas had almost totally disappeared, except for a seasonally denuded area within a shearwater colony on the eastern side, and were vegetated by various species. In 1979 the transect (Fig. 2) demonstrated clearly the changes

TABLE 1
LIST OF PLANTS COLLECTED IN 1959, BY GILLHAM (1961), BETWEEN 1965-8 (NORMAN 1967, 1970) AND IN 1978-1979.

	Recorded in			
	1959	*1965*	*1965-1968*	*1978-1979*
Asplenium obtusatum		+	+	+
Microsorium diversifolium		+	+	+
Pteridium esculentum	+	+	+	+
Scirpus nodosus	+	+	+	+
Juncus pallidus		+	+	sp.
Bulbine bulbosa		+	+	+
Bulbine semibarbata	+			
Dianella revoluta	+	+	+	
Lomandra longifolia				+
Microtis unifolia				+
**Ammophila arenaria*	+		+	+
**Hordeum leporinum*				+
**Poa annua*			+	
Poa poiformis	+	+	+	+
Stipa compacta				+
**Vulpia bromoides*	+			
Carpobrotus rossii	+	+	+	+
Disphyma australe	+	+	+	+
Tetragonia implexicoma			+	
Tetragonia tetragonioides		+	+	+
**Carduus tenuiflorus*	+	+	+	+
Cassinia aculeata				+
Cotula australis		+	+	
Cotula coronopifolia	+			
**Erigeron bonariensis*			+	
Gnaphalium luteoalbum				+
Helichrysum dendroideum			+	+
**Hypochoeris radicata*				+
Olearia axillaris		+	+	+
Senecio lautus	+	+	+	+
**Sonchus oleraceus*		+	+	+
Cakile maritima	+	+	+	+
Wahlenbergia quadrifida			+	sp.
Spergularia media	+			
**Stellaria media*	+	+	+	
Sambucus sp.	+			
Atriplex cinerea		+	+	+
Atriplex hastata	+	+	+	
**Chenopodium album*				+
Rhagodia baccata			+	+
Dichondra repens		+		+
Crassula helmsii			+	
Crassula macrantha				+
Crassula sieberana	+			
Crassula sp.			+	+
Cyathodes acerosa	+	+	+	
Leucopogon parviflorus				+
Lissanthe strigosa			+	
**Centaurium pulchellum*				+
Pelargonium australe			+	+
Lobelia alata	+	+	+	+
Acacia longifolia	+	+	+	+
Leptospermum laevigatum		+	+	+

Kennedya prostrata			+	+
Pultenaea daphnoides			+	
**Trifolium dubium*				+
Muehlenbeckia adpressa	+	+	+	+
Calandrinia calyptrata	+			+
Acaena anserinifolia				+
Correa alba	+	+	+	+
Solanum aviculare				+
Solanum laciniatum		+	+	
**Urtica urens*		+	+	+

which had taken place since 1968 (fig. 7 in Norman 1970). *P. poiformis* tussocks dominated the transect route, *Acacia* bushes (some taller than 3 m) were recorded for the first time and the importance of minor species, such as *Juncus* or *Kennedya*, had declined. Changes are indicated by comparison of Pl. 15, fig. 2 with plate 23 (top) in Norman (1970).

Elsewhere on the island *P. poiformis* remained the dominant species. Occasional strands of *Solanum aviculare* and *Carduus tenuiflorus* covered small areas of shearwater colony as did *Senecio lautus*, though the latter had generally died back. A few bushes of *Correa alba, Acacia* and *Leptospermum* are now established around the island.

(ii) Birds

Most Little Penguin burrows were found just above the shoreline around most of the island, and occasionally within the shearwater colonies. In 1979 most burrows examined held young, and dead birds were found throughout the breeding areas. The population, which may be about 200-500 burrows, does not appear to have altered in size since Gillham's (1961) record of 'many hundreds'.

Short-tailed Shearwater burrows were present wherever soil depth was suitable—indeed this must now limit their distribution on the island. The total numbers of burrows on the island was estimated at 131 000 (95% confidence limits 115 200-146 600; see Table 2). In 1959 many thousands of burrows were present, though there were none in the eroded area nor on the steeper cliffs (Gillham 1961). Some extension of the colony into the eroded area was apparent in 1968 and the expansion has continued since. In 1978 the total number of burrows for some of the area of the original sand blow (II, III and V in Fig. 2) was 44 600. A burrow density of 4/square yard ($3.7/m^2$), suggested by Norman (1970) for the eroded area, was not obtained during this survey. In only one quadrat did the density reach $1/m^2$ and the average burrow density for the island was $0.5/m^2$.

Abandoned eggs were found frequently and, if the numbers of eggs present in quadrats were representative, may have totalled about 4000 for the whole island.

Eight adult and two young Cape Barren Geese *Cereopsis novaehollandiae* were present in 1978; 18 (including at least two juveniles) were counted in 1979 when non-flying goslings (one dead) and an old nest were found. Droppings were present over much of the island and clearly breeding pairs are now established, indeed S. G. Lane (*pers. comm.*) banded non-flying young on the island in November 1979. The species was not recorded by Gillham (1961); Dorward (1967) considered that the island was ignored by geese and none were seen there between 1965 and 1968.

Nests of Sooty Oystercatchers *Haematopus fuliginosus* (3), Silver Gulls *Larus novaehollandiae* (27) and Pacific Gulls *L. marinus* (5) were found in 1979.

The following species have also been recorded on the island: Black-faced Shag *Leucocarbo fuscescens*, White-faced Heron *Ardea novaehollandiae*, Whistling Kite *Haliastur sphenurus*, Marsh Harrier *Circus aeruginosus*, Peregrine Falcon *Falco peregrinus*, Brown Falcon *F. berigora*, Australian Kestrel *F. cenchroides*, Skylark *Alauda arvensis*, Welcome Swallow *Hirundo neoxena*, Fairy Martin *Cecropis ariel*, Richard's Pipit *Anthus novaeseelandiae*, Blackbird *Turdus merula*, Superb Fairy Wren *Malurus cyaneus*, Silvereye *Zosterops lateralis*, European Goldfinch *Carduelis carduelis*, Common Starling *Sturnus vulgaris*, Australian Magpie *Gymnorhina tibicen* and a corvid species. Most observations represent single sightings of transitory individuals and the paucity of resident passerine species is, presumably, due to the simple structure of the island's flora.

TABLE 2
ESTIMATES OF NUMBERS OF BURROWS OF SHORT-TAILED SHEARWATERS ON RABBIT ISLAND IN DECEMBER 1978.

Area	*Area (ha)*	*No. of quadrats*	*Burrow density/m²* *Mean*	*S.E.*	*Number of burrows* *Mean*	*Range*
I	7.43	30	0.460	0.030	34 200	29 800-38 600
II	5.46	29	0.503	0.026	27 500	24 700-30 300
III	1.05	21	0.305	0.065	3 200	1 800- 4 600
IV	8.32	30	0.627	0.030	52 200	47 200-57 200
V	3.10	26	0.448*	0.035	13 900	11 700-15 900
Total					131 000	115 200-146 600

*Possibly too low due to the difficulty of finding burrows among bushes.

DISCUSSION

The revegetation of eroded areas on Rabbit Island, which followed shortly after the elimination of rabbits, was followed by an invasion of such stabilised areas by nesting shearwaters. The absence of rabbits (or their signs) during visits some ten years later (a period in which no fires were recorded on the island), and the dramatic development of the flora (both in size, cover and number of species), support the view that rabbits were effectively depressing the island's vegetation (Gillham 1962, Norman 1970) though drought may have affected species' availability during the earliest collection (Gillham 1961). Clearing of scrub on the island, presumably initiated before 1846, when the island was apparently occupied (Haydon 1846), was probably assisted by the frequent visits of 'birders' or 'eggers', from ship's crews and their passengers and of those seeking recreation, including rabbit shooting, there (Kershaw 1909, Lennon 1973, 1974, 1975). By 1909 the island had 'a little scrub', had 'dense bracken' in places, and was covered by tussocks (Kershaw 1909). In drier periods, rabbits probably further aggravated any erosion in shearwater colonies, and prevented regeneration. Additionally, the frequent landings, and selective grazing by rabbits, would have helped the introduction and expansion of alien plants and also decreased the abundance of sensitive native species. Certainly other Bass Strait islands (e.g. Cliffy Island, Hope & Thompson 1971; Big Green Island, Norman 1966) which were occupied or grazed have more alien species than unoccupied islands. Burning of scrub and grazing by stock can also reduce the distribution of shrubs and modify or eliminate the *P. poiformis* tussock (e.g. in the Hogan Group, Scarlett, Hope & Calder 1974).

One factor influencing the vegetation on Rabbit Island has now been removed, and since 1966 the recovery and recolonisation of the eroded area has allowed expansion of the shearwater colonies. It will be of interest to monitor changes in the future. An increase in the complexity of the island's floristics may well allow the number of birds using the island, particularly passerine species, to increase.

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REFERENCES

Dorward, D. F., 1967. The status of the Cape Barren Goose *Cereopsis novaehollandiae*. *Int. Council Bird Pres.* Xth *Bull.* (1967): 56-71.

Gillham, M. E., 1960. Destruction of indigenous heath vegetation in Victorian sea-bird colonies. *Aust. J. Bot.* 8: 277-317.

———, 1961. Plants and sea birds of granite islands in south-east Victoria. *Proc. R. Soc. Vict.* 74: 21-35.

———, 1962. Granite islands of south-east Victoria as a sea-bird habitat. *Proc. R. Soc. Vict.* 75: 45-63.

Haydon, G., 1846. *Five years experience in Australia Felix.* Hamilton, Adams and Co., London.

Hope, G. S. & Thomson, G. K., 1971. The vegetation of Cliffy Island, Victoria, Australia. *Proc. R. Soc. Vict.* 84: 121-128.

Kershaw, F. E. S., 1909. Unpublished diary of 'Bass Strait Trip'. January 1909 (per courtesy R. C. Kershaw, Launceston).

Lennon, J. L., 1973. Trade and communications across the Straits. Gipp's Land to Van Diemen's Land 1841-1851. *Vict. Hist. Mag.* 44: 95-107.

———, 1974. Wilson's Promontory in Victoria, its commercial utilization in the nineteenth century. *Vict. Hist. Mag.* 45: 179-200.

———, 1975. Our changing coastline. *Vict. Hist. J.* 46: 476-488.

Norman, F. I., 1966. A note on the vegetation of Big Green Island, Furneaux Group, Tasmania. *Victorian Nat.* 84: 239-250.

———, 1967. The interaction of plants and animals on Rabbit Island, Wilson's Promontory, Victoria. *Proc. R. Soc. Vict.* 80: 193-200.

———, 1970. Ecological effects of rabbit reduction on Rabbit Island, Wilsons Promontory, Victoria. *Proc. R. Soc. Vict.* 83: 235-252.

Scarlett, N. H., Hope, G. S. & Calder, D. M., 1974. Natural history of the Hogan Group. 3. Floristics and plant communities. *Pap. Proc. R. Soc. Tasm.* 107: 83-98.

Stokes, J. L., 1846. *Discoveries in Australia*, vol. II. London.

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Plate 15

Fig. 1—Beach on Rabbit Island, December 1979 showing areas dominated by *Atriplex*, *Rhagodia* and *Poa poiformis*. (Compare pl. 23 in Norman 1970).

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Fig. 2—Fixed peg towards Trig. point, December 1979: dense *P. poiformis* backed by *Acacia* shrubs. (Compare pl. 23 in Norman 1970).